4.4 Hazard Area 4 - Upper East Fork Poplar Creek

The Upper East Fork Poplar Creek (UEFPC) watershed, which includes the main industrial area of the Y-12 National Security Complex (formerly the Y-12 Plant), is located between Pine Ridge and Chestnut Ridge in the northeast corner of the ORR and includes approximately 1170 acres. The boundaries of the UEFPC watershed extend along the top of Pine Ridge to the north, the top of Chestnut Ridge to the south, the eastern boundary of the Bear Creek Valley watershed to the west, and the DOE-ORR property boundary (Scarboro Road) to the east. UEFPC also includes a contaminated groundwater plume (the Y-12 Plant East End VOC Plume) that extends beyond the DOE-ORR property boundary to the east into Union Valley, where it terminates at springs and headwaters of Scarboro Creek located near Illinois Avenue. The headwaters of Upper East Fork Poplar Creek are near the S-3 Ponds. When the Y-12 Plant was built, the creek was rerouted through storm drains and its original tributaries were backfilled. The creek exits the ORR near Station 17 at the eastern boundary of the UEFPC watershed.

The Y-12 National Security Complex occupies approximately 600 acres near the northeastern corner of the ORR, adjacent to the city of Oak Ridge. Y-12's original mission was to chemically separate and produce fissile uranium-235 from uranium-238 using an electromagnetic separations process (alpha process) and to manufacture weapons components as part of the national effort to produce the atomic bomb. As other uranium enrichment processes were developed and implemented at other installations, the role of Y-12 expanded to include weapon components manufacturing and precision machining, research and development, lithium isotope separation, and special nuclear materials storage and management. Y-12 continues to be operated by the National Nuclear Security Administration (NNSA) as an active manufacturing and developmental engineering facility. Its current mission includes the manufacturing and reworking of nuclear weapons components, dismantling nuclear weapons components, serving as the nation's stockpile for special nuclear materials, and providing special production support to other programs. More than 50% of the facilities currently in use at the Y-12 site are now more than 50 years old, and the site is undertaking a major modernization program.

The end-state land use at UEFPC assumed under both the current life-cycle baseline and this end state analysis differs somewhat from the recommendations of the EUWG. The EUWG recommended that the future land use at Y-12 should be DOE/NNSA-controlled industrial use within the western and south-central portions of the complex, and unrestricted industrial use in the eastern and north-central plant areas. However, the NNSA has since determined that because of security concerns and the current modernization program, the anticipated land use for the foreseeable future will be DOE/NNSA-controlled industrial use throughout the entire Y-12 complex.

Remediation of the UEFPC watershed is being conducted in stages using a phased approach. The *Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area* (DOE 2002e), issued in May 2002, constitutes the initial phase and addresses interim actions for remediation of principal-threat mercury-contaminated soil, sediment, and point groundwater discharges that contribute contamination to surface water. The

Phase I ROD does not address active facilities or waste management areas. Remedial actions include hydraulic isolation, removal of mercury-contaminated soils and sediments, water treatment, monitoring, and land use controls. The initial action under Phase I is the design and construction of the Building 9201-2 Water Treatment System, which will collect and treat the largest remaining source of mercury in UEFPC. Subsequent actions will include hydraulic isolation of the West End Mercury Area and the removal of contaminated sediments from the UEFPC creekbed and Lake Reality. Principal threat wastes identified in the Phase I ROD include mercury-contaminated soils, storm sewers, and shallow groundwater at the West End Mercury Area; sediments in exposed portions of the UEFPC stream channel; and sediment within Lake Reality. Approximately 4000 yd^3 of contaminated sediment and stream bank soil will be removed from the UEFPC channel and replaced with clean material, and a filter blanket or concrete channel will be installed to prevent erosion. Approximately 8000 yd^3 of additional contaminated sediment will be removed from Lake Reality. Hydraulic isolation of the West End Mercury Area also will be implemented to protect recreational human surface water users and to reduce mercury levels in fish tissue by limiting releases to UEFPC; hydraulic isolation measures under Phase I will include installing caps over mercury runoff areas totaling approximately 3.5 acres, cleaning contaminated sediments from approximately 11,500 linear feet of storm sewers, and relining or replacing approximately 2650 linear feet of storm sewer line.

A Phase 2 remedial action decision, currently under development, will focus on actions for the remediation of the balance of contaminated soil, scrap, buried waste, and subsurface structures in the Y-12 main industrial complex, the major area of contamination in the UEFPC watershed. The *Upper East Fork Poplar Creek Soil and Scrapyard Focused Feasibility Study* (DOE 2003d) was issued in 2003, and the *Proposed Plan for Interim Actions for Contaminated Soils and Scrapyard in Upper East Fork Poplar Creek* (DOE 2004j) was issued for public comment in September 2004. In addition, final remediation goals for surface water and groundwater will be addressed in future decision documents.

The remedial action objective for the actions under the Phase I ROD is to reduce mercury concentrations in surface water to risk-based (human health) levels for recreational use at Station 17, the point where UEFPC exits the ORR. The mercury concentration limit of 200 ppt in UEFPC surface water was derived to limit the risk to potential receptors from the fish ingestion pathway. Mercury contamination in the UEFPC watershed resulted from Y-12 operations to separate isotopes of lithium for use in nuclear weapons. Three similar processes housed in several buildings at Y-12 were used to perform these operations, which involved relatively high flow rates of mercury through numerous pumps, pipes, valves and seals. An estimated total of 2 million pounds of mercury was released to the environment through spills, leaks and other discharges, or not otherwise accounted for – including an estimated 240,000 pounds of mercury released from Y-12 directly to UEFPC from 1950 to 1982. Current concentrations of mercury in UEFPC exceed AWQCs at Station 17; due to these elevated concentrations and the high bioaccumulation rate of mercury, controls have been implemented to prevent consumption of fish from UEFPC and Lower East Fork Poplar Creek.

Remediation levels for contaminants of concern in soil and sediment presented in the Phase 2 Focused Feasibility Study (DOE 2003d) and Proposed Plan (DOE 2004j), as summarized in Table 4-8, are derived to limit risk to a future worker to acceptable levels for DOE/NNSA-

Table 4-8. Soil remediation levels for UEFPC soils (from DOE 2003d)

Target contaminants of concern[a]	Individual remediation levels[b]	Basis for average individual remediation level [c]	Risk corresponding to the individual average remediation level [d]	Residual average cumulative remediation goal[e]
Carcinogens				
Cesium-137+D	Average: 11pCi/g Maximum: 110 pCi/g	Site-specific background + detectability consideration	4×10^{-5}	10^{-4} ELCR
Uranium-235+D	Average: 12 pCi/g Maximum: 120 pCi/g	Risk limit	1×10^{-5}	
Uranium-238+D	Average: 50 pCi/g Maximum: 500 pCi/g	Risk limit	1×10^{-5}	
PCB	Average:10 mg/kg Maximum: 100 mg/kg	Risk limit	1×10^{-5}	
Radium-226+D	Average: 6 pCi/g Maximum: 16 pCi/g	Site-specific background (1.4 pCi/g) + 5 pCi/g	1×10^{-4}	NA
Thorium-232+D	Average: 8 pCi/g Maximum: 19 pCi/g	Site-specific background (2.75 pCi/g) + 5 pCi/g	1.5×10^{-4}	
Noncarcinogens				
Cadmium	Average: 30 mg/kg Maximum: 300 mg/kg	Risk limit	HQ = 1	HI = 3
Mercury	Average: 325 mg/kg Maximum: 3250 mg/kg	Risk limit	HQ = 1	
Uranium	Average: 1150 mg/kg Maximum: 11,500 mg/kg	Risk limit	HQ = 1	

[a] COCs identified in the RI for UEFPC but not listed here include arsenic; beryllium; chromium; 3,3'-dichlorobenzidine; benzo(a)anthracene; benzo(a)pyrene; benzo(b)flouranthene; dibenzo(a,h)anthracene; indeno(1,2,3-cd)pyrene; and Neptunium-237. 3,3'-dichlorobenzidine; benzo(a)anthracene; benzo(a)pyrene; benzo(b)flouranthene; indeno(1,2,3-cd)pyrene; and Neptunium-237 were excluded from the table because all detected soil concentrations are less than the risk level of 1×10^{-5} and/or HI level of 1. Arsenic, chromium, and dibenzo(a,h)anthracene were excluded from the table because they have very low frequencies of detected concentrations above the risk level of 1×10^{-5} and/or HI level of 1. Beryllium was excluded from the table because EPA has reevaluated its carcinogenicity and eliminated its oral slope factor.

[b] The individual remediation level is the average concentration for each target contaminant over an exposure unit (EU) or the maximum for an individual location.

[c] The individual remediation level was primarily based on attaining a 1×10^{-5} industrial risk limit, but the concentrations were set at higher levels for some radionuclides if justified based on cost effectiveness, detectability, and background risk exceeding the risk limit.

[d] This column lists the industrial risk values that correspond to the individual remediation levels. Remediation levels are estimated for an industrial worker exposed to soil using Y-12 Complex site-specific exposure parameters.

[e] The radium-226 and thorium-232 decay series are not included in the aggregate risk calculation for the EU. Rather, the remediation goal for these contaminants is similar to alternate concentration limits specified in 40 *Code of Federal Regulations* 192 and DOE Order 5400.5, and is set as low as reasonably achievable.

COC = contaminant of concern
D = radioactive decay daughter.
ELCR = excess lifetime cancer risk.
EU = exposure unit
FFS = focused feasibility study
HI = hazard index.
HQ = hazard quotient.
NA = not applicable.
PCB = polychlorinated biphenyl.
UEFPC = Upper East Fork Poplar Creek

controlled industrial land use. An exposure unit approach is used, which establishes an average remediation level across an exposure unit that will not be exceeded and a maximum remediation level not to be exceeded at any location. Contaminated soil in an EU will be remediated so that the residual concentration averaged across the exposure unit will be at or below the corresponding average remediation level, and the maximum contaminant concentration found at any location will be at or below the corresponding maximum remediation level. Contaminants of concern include uranium, mercury, radium-226, thorium-232, cesium-137, cadmium, and PCBs. Remediation levels for individual contaminants are generally set at risk-based levels not to exceed 1×10^{-5} ELCR for carcinogens and HQ of 1 for noncarcinogens, except where higher

levels are justified by cost effectiveness, detectability, and background considerations. Maximum remediation levels are set at 10-times the average concentration limit for all COCs except radium and thorium. For radium and thorium, average and maximum remediation levels are based on alternative concentration limits specified in 40 CFR 192 and DOE Order 5400.5. In addition to the remediation levels for individual contaminants of concern, the cumulative risk to the future worker from all contaminants may not exceed 1×10^{-4} ELCR and HI ≤ 3, excluding the radium and thorium decay series.

In addition to the risk-based criteria for protection of the industrial worker summarized in Table 4-8, remedial action objectives also call for remediation of any soils determined to be contributing to groundwater contamination that exceeds 1×10^{-4} ELCR for an industrial drinking water scenario, and any soils determined to be contributing to surface water contamination by mercury exceeding the 200 ppt criterion in the Phase I ROD. The selected remedy also is expected to provide protection of aquatic populations in surface water through the removal of contaminated sediments and other sources of contaminants.

Accessible soil exceeding the remediation levels in Table 4-8 would be excavated to a depth of up to 2 ft to protect the future industrial worker. Currently inaccessible soils (e.g., soil beneath buildings, critical active utilities, roads, etc.) would be remediated if it becomes accessible in the future. Deeper soils and buried waste exceeding remediation levels (estimated not to exceed 40,000 yd^3) would be institutionally controlled to prevent unacceptable access. Institutional controls also would be implemented to prevent unrestricted use. Preliminary data suggest that all exposure units have at least one soil sampling location with a maximum result above the maximum remediation levels, which would require excavation. Only a few EUs, however, are estimated to exceed average remediation levels, following removal of these hot-spots. The majority of contaminated soil potentially requiring excavation is located in the Old Salvage Yard, estimated at 25,000 to 40,000 yd^3. Uranium-238 concentrations in soil and buried waste could be as high as 100,000 pCi/g; PCB levels in surface soil are less than 50 ppm, and mercury levels are less than 2000 ppm.

UEFPC Current State:

More than 70 sources of contamination have been identified within the Upper East Fork Poplar Creek watershed. Major sources include:

- The area contains an almost continuous nitrate- and uranium-contaminated groundwater plume, which originates from the S-3 Ponds and other sources within the plant. This plume, located deep in bedrock (300 to 400 feet), has migrated 400 feet vertically and 4000 feet laterally from its sources. It also contains other radionuclides and metals.
- A carbon tetrachloride-contaminated groundwater plume exists in the east end of the site and extends off site under the Union Valley Industrial Park. The source of this plume is unknown; however, carbon tetrachloride was used in large amounts from 1943 to 1946 in processing source material for the electromagnetic separation process. An early action for collection and treatment of this East End VOC Plume is ongoing to control migration.
- Upper East Fork Poplar Creek surface water and sediments are contaminated with mercury from groundwater discharge and overland flow.

- Two ponds have been used to handle contaminated surface water exiting the Y-12 National Security Complex prior to entering Lower East Fork Poplar Creek. These ponds concentrated mercury and other contaminants in sediments. New Hope Pond was closed in 1989 under the Resource Conservation and Recovery Act but may still be contributing to groundwater contamination. A new lined pond, Lake Reality, was opened in 1988 when New Hope Pond was drained; contaminated sediment has accumulated in Lake Reality, and the flow in Upper East Fork Poplar Creek is currently routed around Lake Reality.
- The Salvage Yard, located in the western end of Y-12, has been used since the early 1970s to receive scrap metal from plant operations, and contains approximately 20,000 ft^3 of radiologically contaminated (primarily uranium-contaminated) scrap.
- Alpha 4, Building 9201-2, and other buildings are contaminated with mercury from historical operations.
- The East End Garage, located in the eastern portion of Y-12, is a former fuel storage and distribution facility with several underground storage tanks; while all tanks have been previously removed, petroleum-related compounds and chlorinated organics in soil and groundwater remain.
- The Beta-4 Security Pits are non-RCRA-regulated disposal areas in the western portion of the Y-12 complex, consisting of four earthen pits formerly used for disposal of classified waste, including uranium, beryllium, metals, organics, acids, and miscellaneous debris.
- The Coal Pile Trench, located in the southwestern portion of the Y-12 complex near the Steam Plant (Building 9401-3), is an earthen trench in which classified uranium wastes and other materials were disposed until 1966. The trench now is completely covered with coal used for steam generation at Y-12.

The Baseline Risk Assessment (DOE 1998b) identified the following potentially unacceptable risks for the UEFPC watershed:

- Sediment Contamination - Mercury, PCBs, and other COCs in sediments of UEFPC present unacceptable risk (ELCR $>1 \times 10^{-4}$ or HQ > 1) to a future recreational receptor via the dermal exposure pathway.
- Surface Water Contamination – Mercury in UEFPC surface water exceeds AWQC (51 ppt) and risk-based levels for ingestion of fish by recreational receptors (200 ppt). PCBs also pose an unacceptable risk for ingestion of fish from UEFPC.
- Soil Contamination – Radionuclide (uranium, cesium-137, radium-226) and PCB levels in contaminated soil at the Y-12 site exceed risk-based levels for industrial workers, which would present an unacceptable risk ($>1 \times 10^{-4}$ ELCR) to workers in the absence of current controls. Total radiological risks to the hypothetical industrial worker in the eastern, central and western areas of the plant are estimated at 8×10^{-4}, 5×10^{-4}, and 2×10^{-3}, respectively, with direct external exposure as the predominant exposure pathway. Risks from dermal exposure to PCBs are estimated at 7×10^{-5}, 2×10^{-5}, and 1×10^{-5} in the eastern, central and western portions of the site, respectively.
- Groundwater Contamination – VOC contamination in groundwater exceeds MCLs and acceptable risk levels ($>1 \times 10^{-4}$ ELCR) for the future industrial worker onsite and the future residential receptor offsite.

- Ecological Impacts – Levels of mercury and PCBs in fish tissue were considered to pose an unacceptable risk to both fish and fish-eating birds; radionuclide concentrations were not determined to present unacceptable risk to any ecological receptors.

Life-Cycle Baseline for UEFPC:

Under the current baseline, certain actions with opportunities for high risk reduction in UEFPC would be completed by 2008:

- Installation of the Building 9201-2 Water Treatment System to mitigate off-site release of mercury via surface water releases to UEFPC. Design of the treatment facility was completed in 2003. The system will use a series granular activated carbon beds to reduce mercury concentration in the system effluent to levels of 200 ppt or less. The system influent will include Outfall 51 and 9201-2 sump water.
- Bioremediation to mitigate the offsite East End VOC Plume. This bioremediation treatment would be used to enhance or replace the ex-situ pump-and-treat technology that has been in operation at this site since 2000 to reduce carbon tetrachloride concentrations.

The remainder of remedial actions in the UEFPC watershed would be completed by 2015, including the following:

- Alpha 4 and unneeded waste management facilities will be demolished.
- Mercury- and PCB-contaminated soil and sediment will be excavated, and subsurface contamination beneath process buildings will be hydraulically isolated.
- Groundwater exiting the Y-12 site will be collected and treated in above-ground treatment facilities or in-situ.
- The offsite VOC plume in Union Valley will be managed with institutional controls.
- Contaminated scrap metal will be removed.
- Soils containing contaminants of concern above risk-based levels will be removed.
- Institutional controls will be maintained in perpetuity to control future land use, to restrict access to soils below the depth of remediation, and to prohibit onsite use of groundwater.

End State Vision for UEFPC:

The Y-12 National Security Complex is expected to continue operations for the foreseeable future in support of national security needs. Current baseline plans for UEFPC are designed to support the planned DOE/NNSA-controlled industrial use of the Y-12 site, and remediation criteria are being derived to achieve an acceptably low level of risk to the future workers. The Phase I ROD for UEFPC primarily addresses release of mercury in surface water exiting the ORR, and planning for Phase 2 remedial actions to address other contaminated soil, scrap, buried waste and subsurface structures is currently underway. These actions will be designed to build on previous interim measures, including RCRA closures of the S-3 Ponds, New Hope Pond and other facilities, and the ongoing groundwater treatment operations to control the migration of an offsite VOC plume. Actions planned under the life-cycle baseline are considered to be

consistent with remedial actions designed solely on the basis of the end state vision. Therefore, no specific variances have been identified.

Under the current baseline plan, soil and sediment in the UEFPC watershed is expected to be remediated to a maximum depth of 2 feet to risk-based criteria derived to limit the potential risk to a future industrial worker not to exceed 1×10^{-4} ELCR and HI ≤ 3. Source control measures currently being implemented under the Phase I ROD to reduce the release of mercury in surface water exiting the ORR include hydraulic isolation of mercury-contaminated areas, cleaning and relining of storm sewers in high mercury use areas, removal of contaminated sediments from UEFPC and Lake Reality, groundwater treatment, monitoring, and land use controls. Phase 2 actions will include the removal and offsite disposal of soil, scrap, and buried wastes containing contaminants of concern above risk-based levels, estimated to include 25,000 to 40,000 yd^3 of radiologically contaminated surface soil, 150 yd^3 of mercury-contaminated subsurface soil and buried waste exceeding Phase I objectives for release to surface water, and up to 25,000 yd^3 of contaminated scrap. The current pump-and-treat system for controlling the spread of the East End VOC Plume is planned to be replaced by a passive in-situ bioremediation system. While the concentration of carbon tetrachloride in the off-site groundwater plume exceeds levels that present an unacceptable future risk to an offsite industrial or residential receptor using groundwater as a drinking water source in the Union Valley area, there is no current use of groundwater at this location. The protection of surface water and groundwater to risk-based levels are also identified as remedial action objectives for the proposed soil action, although final goals for surface water and groundwater are deferred to a future decision.

Under the phased approach for UEFPC, Phase I actions are designed to address principal-threat mercury-contaminated soil, sediment, and shallow groundwater contributing to UEFPC surface water contamination. Phase 2 actions will be designed to address risks to a future industrial worker from contaminated soil, buried waste, and scrap material, and to further reduce contributions to groundwater and surface water contamination from these sources. And final protection goals for surface water and groundwater will be determined in a future decision.

Maps of the UEFPC under current and end state conditions are provided in Figures 4.4a1 and 4.4b1. Conceptual site models under current state and end state conditions are illustrated in Figures 4.4a2 and 4.4b2, respectively.

The end state scenario for UEFPC is considered identical to the current baseline. Buildings, soils and other materials containing contaminants above risk-based criteria for future industrial use will be removed from the site for off-site disposal. A long-term stewardship program will ensure the continuing protectiveness of the remedy, including continuing surveillance and maintenance. Groundwater monitoring wells will require periodic maintenance and replacement at longer intervals (assumed 30 years). The passive in-situ bioremediation treatment system for the East End VOC plume is expected to require less maintenance than the current pump-and-treat system. Since contaminants will remain on site above levels suitable for unlimited use and unrestricted exposure, a statutory review will be conducted at least every five years to ensure that the remedy continues to be protective of human health and the environment. The NNSA will retain ownership of the Upper East Fork Poplar Creek watershed and the remainder of the Y-12 National Security Complex for the foreseeable future.

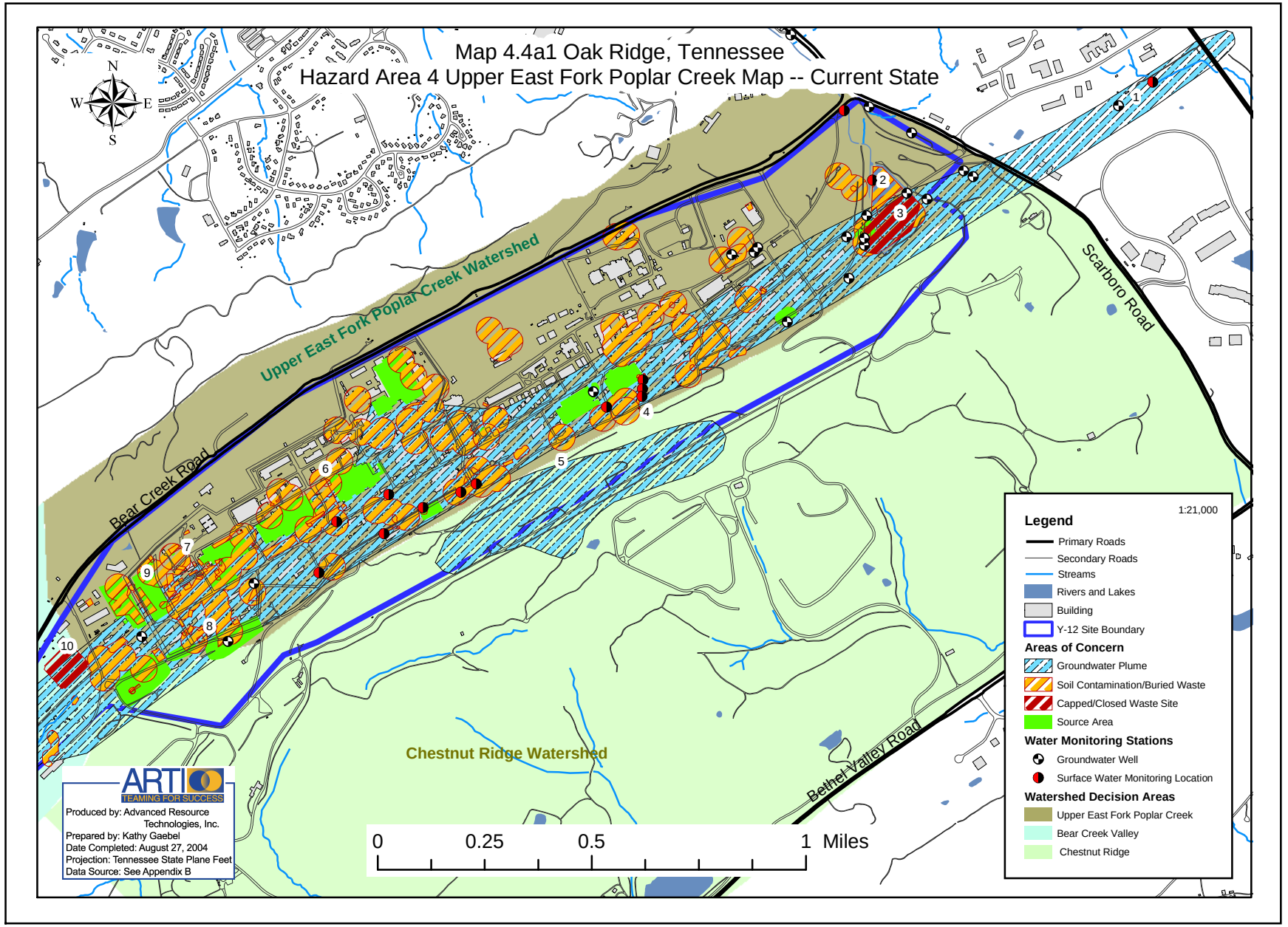
Map 4.4a1 Oak Ridge, Tennessee
Hazard Area 4 Upper East Fork Poplar Creek Map -- Current State
N
W
E
S
Upper East Fork Poplar Creek Watershed
Bear Creek Road
Scarboro Road
Bethel Valley Road
Chestnut Ridge Watershed
1
2
3
4
5
6
7
8
9
10
0
0.25
0.5
1 Miles
1:21,000
Legend
Primary Roads
Secondary Roads
Streams
Rivers and Lakes
Building
Y-12 Site Boundary
Areas of Concern
Groundwater Plume
Soil Contamination/Buried Waste
Capped/Closed Waste Site
Source Area
Water Monitoring Stations
Groundwater Well
Surface Water Monitoring Location
Watershed Decision Areas
Upper East Fork Poplar Creek
Bear Creek Valley
Chestnut Ridge
ARTI
TEAMING FOR SUCCESS
Produced by: Advanced Resource Technologies, Inc.
Prepared by: Kathy Gaebel
Date Completed: August 27, 2004
Projection: Tennessee State Plane Feet
Data Source: See Appendix B

Figure 4.4a1 Continued

Notes for Upper East Fork Poplar Creek current state map:

1. East-End Groundwater Plume – Off-site VOC contamination exceeds risk-based levels for residential or industrial use, but there is no current use of this groundwater; pump-and-treat remedy currently in progress.

2. Lake Reality – The 2.5-acre lined retention basin constructed after closure of New Hope Pond, has accumulated mercury-contaminated sediments.

3. New Hope Pond – Former sediment and flow-control basin; closed under RCRA in 1989; post-closure monitoring program in place.

4. Upper East Fork Poplar Creek - Stream channel and sediment contaminated with mercury and other radioactive and chemical COCs.

5. Building 9418-3 Uranium Vault – Underground concrete vault used for temporary storage of approximately 200 metric tons of non-enriched uranium oxide dross.

6. West-End Mercury Area – Mercury-contaminated buildings, associated process piping and tanks, storm sewer lines, and soils, resulting from lithium isotope separation operations conducted from 1950 to 1963; an estimated 230,000 pounds of elemental mercury was lost from processing operations in this area, primarily before 1960.

7. Beta-4 Security Pits – Non-RCRA landfill consisting of four pits used for disposal of classified waste; an abandoned nitric acid pipeline located between the pits and a catch basin to the south.

8. Salvage Yard Oil/Solvent Drum Storage Area – Former RCRA waste container storage area located in the northwestern part of the Y-12 Plant within the northern portion of the Salvage Yard; drums were stored in two areas on a compacted gravel/soil base with a clay and gravel berm on the downgradient side; combined storage capacity of approximately 3000 55-gallon drums containing radioactively and chemically contaminated waste oils, and solvents; RCRA closure conducted 1986-1989.

9. Interim Drum Yard – Former RCRA waste container storage area in the southwestern portion of the Y-12 Plant, consisting of a gravel lot over native soil; RCRA closure actions conducted 1986-1996, but closure was never certified.

10. S-3 Ponds – S-3 Ponds, which were closed under RCRA in 1988, are physically located in Bear Creek Valley watershed, but are a source of groundwater contamination in UEFPC.

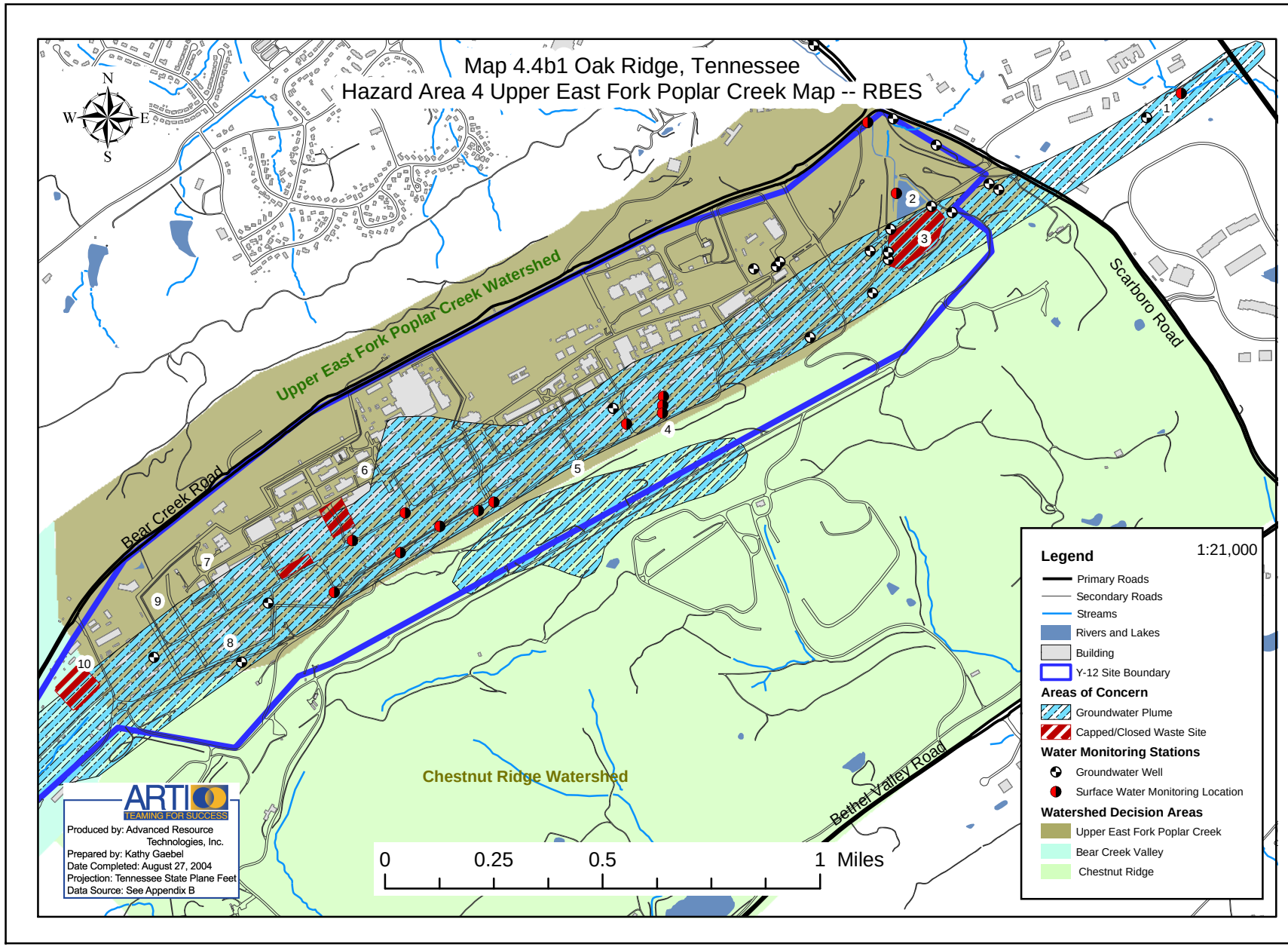
Map 4.4b1 Oak Ridge, Tennessee
Hazard Area 4 Upper East Fork Poplar Creek Map -- RBES
N
W
E
S
Upper East Fork Poplar Creek Watershed
Bear Creek Road
Scarboro Road
Bethel Valley Road
Chestnut Ridge Watershed
1
2
3
4
5
6
7
8
9
10
0
0.25
0.5
1 Miles
1:21,000
Legend
Primary Roads
Secondary Roads
Streams
Rivers and Lakes
Building
Y-12 Site Boundary
Areas of Concern
Groundwater Plume
Capped/Closed Waste Site
Water Monitoring Stations
Groundwater Well
Surface Water Monitoring Location
Watershed Decision Areas
Upper East Fork Poplar Creek
Bear Creek Valley
Chestnut Ridge
ARTI
TEAMING FOR SUCCESS
Produced by: Advanced Resource Technologies, Inc.
Prepared by: Kathy Gaebel
Date Completed: August 27, 2004
Projection: Tennessee State Plane Feet
Data Source: See Appendix B

Figure 4.4b1 Continued

Notes for Upper East Fork Poplar Creek End State map:

1. East-End Groundwater Plume – Off-site VOC contamination exceeds risk-based levels for residential or industrial use, but there is no current use of this groundwater; pump-and-treat remedy currently in progress to be replaced by in-situ bioremediation treatment remedy.

2. Lake Reality – Contaminated sediments will be removed for disposal, and basin will be renovated for use as stormwater retention pond.

3. New Hope Pond – RCRA closure completed 1990, post-closure monitoring program in place.

4. Upper East Fork Poplar Creek – Contaminated sediments will be removed from stream channel for disposal; Building 9201-2 water treatment system will be constructed to remove mercury from the discharge from Outfall 51 and groundwater collected in sumps, the largest remaining point source of uranium in UEFPC.

5. Building 9418-3 Uranium Vault – Uranium oxide waste will be removed for permanent disposal.

6. West-End Mercury Area – Hydraulic isolation measures will include installation of caps over mercury runoff areas, and relining/cleaning mercury-contaminated storm sewer lines.

7. Beta-4 Security Pits – Waste and contaminated soils will be remediated to risk-based criteria for industrial use.

8. Salvage Yard Oil/Solvent Drum Storage Area – Residual contaminated soils will be remediated to risk-based criteria for industrial use.

9. Interim Drum Yard – Residual contaminated soils will be remediated to risk-based criteria for industrial use.

10. S-3 Ponds - S-3 Ponds, which were closed under RCRA in 1988, are physically located in Bear Creek Valley watershed, but are a source of groundwater contamination in UEFPC.

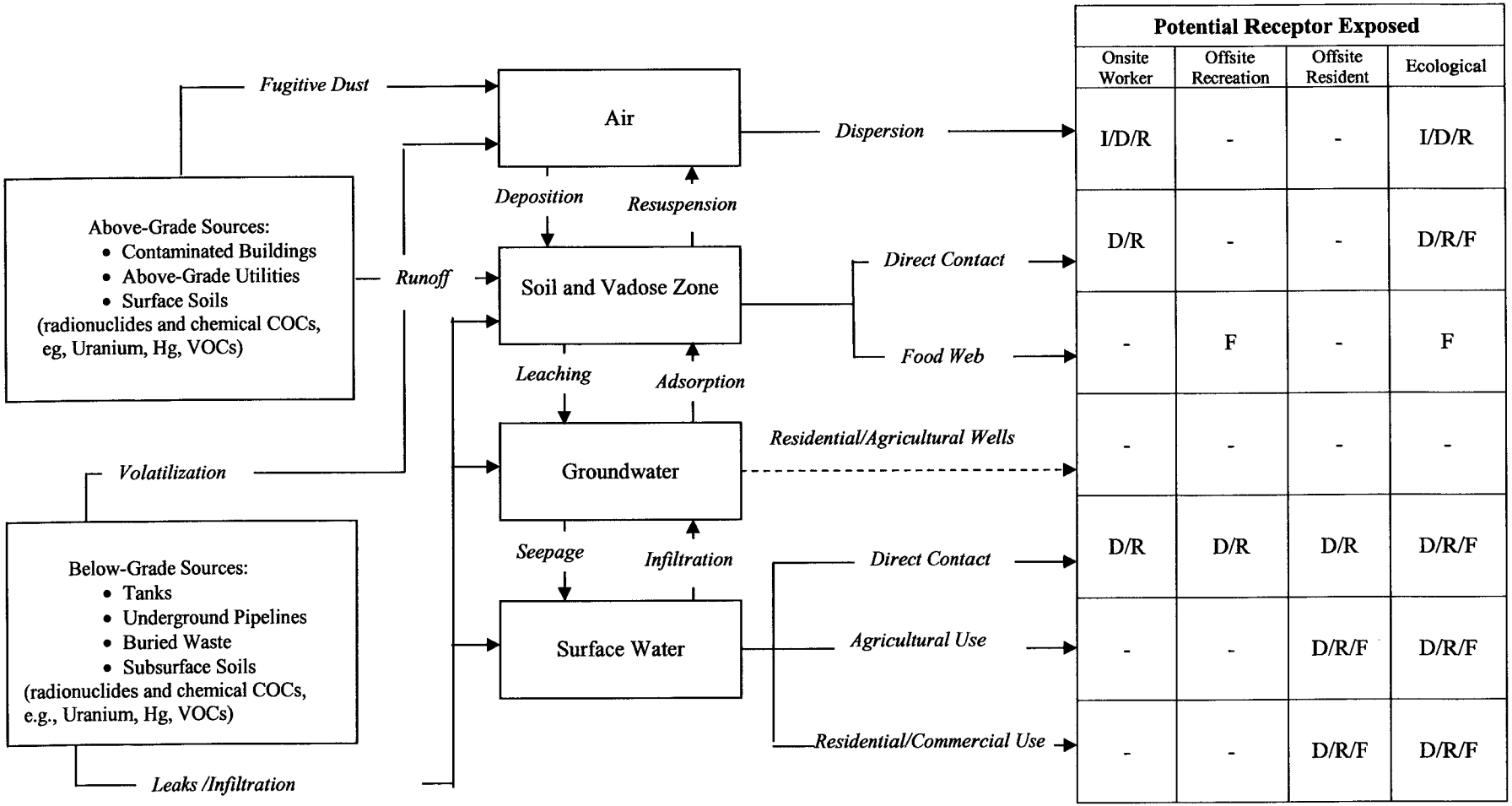

Figure 4.4a2, Conceptual Site Model – Hazard Area 4, Upper East Fork Poplar Creek – Current State

Narrative:

Contaminant Sources:

Hazard Area 4, Upper East Fork Poplar Creek, includes the main industrial complex of the Y-12 National Security Complex. This is a major industrial complex with hundreds of large buildings and an extensive industrial infrastructure of roadways, pipelines, and other utilities. Site operations during the past 60 years have included a number of manufacturing and machining operations involving a variety of hazardous materials, including uranium, mercury, beryllium, and VOCs. Y-12 remains an active facility with an important current and future mission in support of national security, and is currently embarking on a major modernization program to replace aging buildings and infrastructure.

Under current state conditions, numerous buildings, above- and below-grade pipelines and other utilities, tanks, soils and buried wastes contain contaminants of concern in concentrations above preliminary site remediation levels (the CERCLA decision documents to determine remediation criteria are currently under development). While remediation criteria are not yet finalized, they are expected to be risk-based values, derived to protect the future industrial worker at the Y-12 facility. Contaminants of concern include radionuclides (primarily uranium), Hg and other metals, and VOCs.

Current State Exposure Pathways and Receptors:

Under current conditions, potentially complete exposure pathways for onsite workers include: inhalation of particulates or volatiles; and direct exposure to contaminants in soils, buildings/structures, waste and surface water. Potentially complete exposure pathways to off-site recreationists include direct contact with surface water and ingestion of fish. Ecological receptors potentially may be exposed to contaminants in air, soil, surface water and the food chain. The Upper East Fork Poplar Creek exits the ORR about 0.5 km below Station 17 and flows through the city of Oak Ridge (designated Lower East Fork Poplar Creek outside the ORR boundary); potentially complete exposure pathways to offsite residents include direct contact with surface water exiting the ORR, fish ingestion, and use of contaminated surface water for irrigation of home gardens. There is no current use of groundwater at UEFPC for residential, commercial, or agricultural purposes. A VOC groundwater plume extends offiste east from the Y-12 site into the Union Valley area, containing levels of carbon tetrachloride that present an unacceptable risk to a hypothetical offsite residential or industrial receptor obtaining drinking water from this source; however, there is no current use of this groundwater, so this potential exposure pathway is not complete.

Figure 4.4a2, Conceptual Site Model – Hazard Area 4, Upper East Fork Poplar Creek – Current State

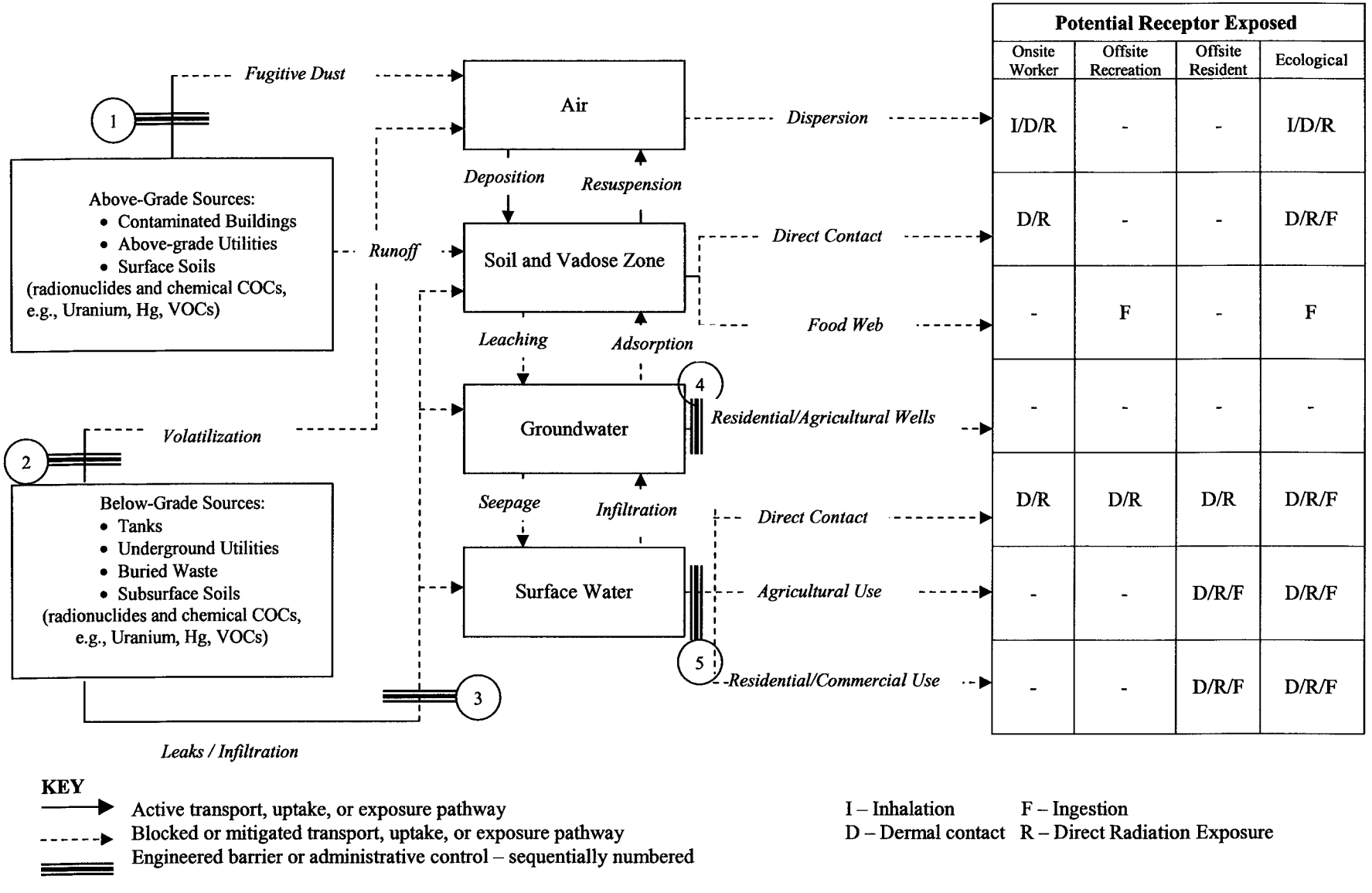

Figure 4.4b2, Conceptual Site Model – Hazard Area 4, Upper East Fork Poplar Creek – End State

Narrative:

Contaminant Sources:

Under both current life-cycle baseline and end state conditions, the Upper East Fork Poplar Creek watershed will remain under DOE/NNSA control as the operations of the Y-12 National Security Complex continue for the foreseeable future. All buildings, pipelines and other utilities, soils, and other sources containing contaminants above remediation critieria derived for DOE/NNSA industrial use will be remediated. Residual contamination below the risk-based remediation criteria will remain in soils, sediments, surface water and groundwater, thus precluding unrestricted use of the site but not posing an unacceptable risk to future DOE/NNSA industrial workers. Institutional controls will include restrictions on future groundwater use.

End State Barriers/Interventions:

The steps taken to mitigate or remove these hazards are as follows:

1. Contaminant levels in buildings, utilities and soils will be reduced below risk-based remediation criteria. While remedial actions and criteria have yet to be finalized in the ROD, soils and sediments in the UEFPC watershed are expected to be remediated to a maximum depth of 2 ft to risk-based criteria designed to limit the potential risk to the future DOE/NNSA worker not to exceed 1×10^{-4} ELCR and HI < 1. Residual contaminant levels will be below levels of concern for fugitive dust emissions and direct radiation exposure.
2. Contamination above risk-based remediation levels in tanks, below-grade pipelines and utilities, and soils will be removed for offsite disposal, eliminating potential for airborne emissions. Buried wastes would be excavated for offsite disposal or contained in place via capping. Residual contamination levels also will be below levels of concern for direct radiation exposure.
3. Remediation of contamination above risk-based remediation levels in tanks, below-grade pipelines and utilities, soils, and buried waste will eliminate potential for continuing releases to surface water or groundwater. Residual contamination levels also will be below levels of concern for direct radiation exposure.
4. Future land use is restricted to DOE/NNSA-controlled industrial use, with prohibitions on onsite use of groundwater. A VOC plume extends offsite to the east of the Y-12 site into the Union Valley area. The pump-and-treat system currently in place to contain this plume will be replaced by an in-situ bioremediation treatment system. Long-term stewardship and institutional controls will ensure continuing protectiveness of the remedy. Surveillance and maintenance will include monitoring of surface water and groundwater, with periodic maintenance and replacement of groundwater wells and ongoing maintenance of capped areas as required.
5. Actions under the Phase I ROD are designed to reduce the release of Hg in surface water exiting the ORR; these actions include hydraulic isolation of mercury-contaminated areas, removal of contaminated sediments from UEFPC and Lake Reality, groundwater treatment, monitoring, and land use controls.

Since contaminants will remain on site above levels suitable for unlimited use and unrestricted exposure, a statutory review will be conducted at least every five years to ensure that the remedy continues to be protective of human health and the environment. These reviews will evaluate any failure of remedial measures and the sustainability of the remedy. Potential failure modes could include breaches of capping/containment systems, unauthorized access to soils at depths below 2 ft, unauthorized use of groundwater, or unauthorized land use.

Figure 4.4b2, Conceptual Site Model – Hazard Area 4, Upper East Fork Poplar Creek – End State